

MEMO

DATE: September 1, 2005
TO: Energy and Environment Committee
FROM: Ted Harris, Air Quality Program Manager, 213-236-1916, harrist@scag.ca.gov
SUBJECT: Localized Air Pollution Health Effects of Ultrafine Particles

SUMMARY:

Per the request of the Energy and Environment Committee (EEC), Dr. Ed Avol, Professor of Environmental Health, Keck School of Medicine, University of Southern California, will give a presentation on potential health risks associated with exposure to ultrafine particles from traffic exhaust. The purpose of the presentation is to respond to the EEC's request to learn more about the severity of localized particulate pollution problems, including emerging science on ultrafine particles.

BACKGROUND ATTACHMENT:

Traffic-Related Pollution and Health Concerns: A Brief Summary of the Research

TRAFFIC-RELATED POLLUTION AND HEALTH CONCERNS: A Brief Summary of the Research

Background: There is increasing concern about the links between motor vehicle emissions and health effects. Particular concerns have been raised about the potential health effects of living in close proximity to busy roads or freeways or close to rail yards and other facilities where diesel emissions are common. Emerging science is raising concerns about exposure to ultrafine particles from traffic exhaust; these particles are smaller than 0.1 microns in diameter.

What the scientific research is telling us about:

- **Traffic pollutants.** Traffic pollutants include carbon monoxide, oxides of nitrogen, hydrocarbons, particles (soot), and other constituents. When hydrocarbons and oxides of nitrogen react in the presence of sunlight, ozone is formed. Heavy duty trucks, ships, locomotives and some buses emit diesel exhaust or diesel particulate.
- **Diesel particulate.** Diesel particulate is regulated by the State of California as a Toxic Air Contaminant, based on studies showing that exposure is linked to lung cancer. In the South Coast Air Basin, Port-related emissions are the source of at least 25% of the diesel particulate in the air.
- **Elemental carbon levels** (as an indicator of diesel emissions) are elevated next to freeways that have a large volume of heavy duty trucks. Elemental carbon levels near the 710 Freeway are higher than those near the 405 Freeway.^{1 2}
- **Ultrafine particles.** Ultrafine particles are emitted by both cars and trucks. Most of the particulate matter that comes out of truck exhaust consists of fine and ultrafine particles, which are both very small in diameter. Scientists are concerned about ultrafine particles because they 1) are found in higher numbers compared to larger particles, 2) have large surface areas onto which a wide range of chemicals and allergens are adsorbed,³ 3) can stay in the air for hours or days after they are emitted, 4) are efficient at getting into the lungs, 5) are biologically potent, 6) can get into the mitochondria of cells and do damage, and 7) can even travel to the brain when inhaled.⁴
- **The numbers of ultrafine particles** are very high close to busy freeways, based on studies done of both the I-405 and I-710 Freeways. The numbers of particles drop off dramatically by 150 meters from the freeway and are nearly down to background levels by 300 meters.⁵
- **Respiratory health effects.** In the USC Children's Health Study conducted in California, teenagers who grew up in smoggy communities with elevated levels of traffic-related pollutants were nearly five times as likely to have clinically low lung function, compared to teens living in low-pollution communities.⁶ Children with asthma who live in communities where there are high levels of particulate matter develop other respiratory health problems, such as bronchitis, compared to children with asthma who live in communities with lower levels of pollution.⁷
- **Reproductive health effects.** Women in large urban areas who are exposed to high levels of traffic-related pollutants when pregnant have an elevated risk of giving birth to babies with heart defects.⁸

- **Cardiovascular disease and cancer.** There is a significant link between ambient urban air pollution, especially particles, and increases in cardiopulmonary disease and mortality from both heart-related illnesses and lung cancer.⁹ Elevated rates of mouth and throat cancers have been found in census tracts directly east of the I-710 Freeway in Long Beach, possibly linked to diesel exhaust exposure.¹⁰ More than 25% of the traffic on that freeway is big-rig trucks.
- **Effects of living near a busy road or freeway.** A recent series of studies completed in the Netherlands indicated that children living near roads with high intensity of truck traffic have lower lung function and more chronic respiratory symptoms compared with children living on roads with less truck traffic.¹¹ A study in California by USC researchers finds that children living near a busy road or freeway are significantly more likely to have asthma than children living further away.¹² Stroke mortality has also been found to be higher in residents living within 200 meters of a busy road.¹³

For more information:

Some of the research described above has been conducted by scientists affiliated with USC and UCLA. Three centers in Southern California are involved in research on traffic-related pollution and health effects. The centers all have investigators from both USC and UCLA. The three centers include:

Southern California Environmental Health Sciences Center, directed by Dr. John Peters. See <http://www.usc.edu/medicine/scehsc> for more information. The Center's Exposure Assessment Field Studies Core is directed by Ed Avol. Its Community Outreach and Education Program is directed by Andrea Hricko. The Center staff can be reached at scehsc@usc.edu.

Children's Environmental Health Center, directed by Dr. Frank Gilliland.

Southern California Particle Center, directed by Dr. John Froines. See <http://www.ph.ucla.edu/scpcs/>



¹ Zhu Y et al. (2002). Study of ultrafine particles near a major highway with heavy-duty diesel traffic. *Atmos Environ* 36: 4323-4335.

² Zhu Y et al. (2002). Concentration and size distribution of ultrafine particles near a major highway. *J Air Waste Manag Assoc* 52(9): 1032-42.

³ Sioutas C et al. (2005). Exposure Assessment for Atmospheric Ultrafine Particles (UFPs) and Implications in Epidemiologic Research. *Environ Health Perspect* 113(8):947-55.

⁴ Oberdorster G et al. (2004). Translocation of inhaled ultrafine particles to the brain. *Inhal Toxicol* 16(6-7):437-45.

⁵ Zhu et al, see above.

⁶ Gauderman J et al. (2004). The effect of air pollution on lung development from 10 to 18 years of age. *N Engl J Med* 351(11):1057-67.

⁷ McConnell R et al. (2003). Prospective Study of Air Pollution and Bronchitic Symptoms in Children with Asthma. *Am J Respir Crit Care Med* 168(7):790-797.

⁸ Ritz B et al (2002). Ambient air pollution and risk of birth defects in Southern California. *Am J Epidemiol* 155(1): 17-25.

⁹ Weinhold B. (2004). Environmental Cardiology: Getting to the Heart of the Matter. *Environ Health Perspect* 112(15):A880-7.

¹⁰ Mack T (2004). *Cancers in the Urban Environment. Patterns of Malignant Disease in Los Angeles County and Its Neighborhoods.* London: Elsevier Academic Press.

¹¹ Brauer M et al. (2005). Air pollution from traffic and the development of respiratory infections and asthmatic and allergic symptoms in children. *Am J Respir Crit Care Med* 166(8):1092-8.

¹² McConnell R et al. (2005). *Association of Childhood Asthma with Residence near a Major Road*, American Thoracic Society International Conference, San Diego. Mini-symposium: Air Pollution Effects in Children, Abstract No. B85, May 23, 2005.

¹³ Maheswaran R et al. (2003). Stroke Mortality Associated with Living Near Main Roads in England and Wales: A Geographical Study. *Stroke* 34(12):2776-80.